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Tableau-Based Business Intelligence Analysis For the 4P Strategy and Product Sales KPIs in Vending Machines at Minori Group

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Abstract

This study aims to analyze the application of Business Intelligence (BI) using Tableau in supporting data-driven decision making in the marketing mix strategy (4Ps) and Key Performance Indicators (KPIs) for vending machine product sales at Minori Group. With the increasing need for efficiency and competition in the South Cikarang industrial area, Minori Group faces challenges in integrating marketing and sales data scattered across various sources. The research method used is a descriptive quantitative approach with the following stages: data collection from vending machine applications, data cleaning using Excel, integration into Tableau for visual analysis, interpretation of visualization results, and preparation of strategic recommendations. The results show that visualization with Tableau is able to provide a comprehensive picture of product performance based on the aspects of Product, Price, Place, and Promotion. The main findings show that inconsistent product placement per slot (BIN) causes sales analysis to be less accurate, while KPI calculations reveal significant variations in performance between products. Tableau has proven to be effective in helping management identify sales patterns, high-performing products, and areas that need to be optimized through promotional strategies and slot rearrangement. The integration of Marketing Mix theory, Business Intelligence, and Technology Acceptance Model (TAM) confirms that Tableau not only serves as a visualization tool, but also as a strategic platform in building a data-driven organizational culture. The implementation of BI through Tableau is expected to increase marketing effectiveness, operational efficiency, and company profitability.

Keywords:
Tableau; Business Intelligence; 4P Marketing Mix; Sales KPI; Vending Machine.

1. INTRODUCTION

In the digital economy era, characterized by the acceleration of information flow and increasingly fierce market competition, companies are required to be able to make data-driven decisions. One area that has undergone significant transformation is marketing analysis, particularly in managing and evaluating the effectiveness of the 4Ps of marketing mix (Product, Price, Place, Promotion) and measuring sales performance through Key Performance Indicators (KPIs). In this context, Minori Group, as a company operating in the South Cikarang industrial area, faces a similar challenge, namely how to utilize abundant marketing and sales data to improve the effectiveness of its marketing strategies and business competitiveness, particularly in the vending machine business line.

Vending machines first appeared in ancient Egypt in the first century AD, invented by the Hero of Alexandria, who made a machine to sell holy water in temples (Alifuddin, 2019). This concept then developed in England in the early 19th century with machines that sold postcards. In the late 19th century,

vending machines began to become popular in the United States, especially for selling chewing gum (Anwar, Adikara, Setiyati, Satria, & Satriawan, 2021). Since then, vending machines have continued to evolve, selling a variety of products and adopting advanced technologies such as digital payments and touchscreens, until they became the efficient and versatile automated devices we know today (Muftie, 2022).

South Cikarang is one of the most strategic industrial areas in Indonesia, where various manufacturing and technology companies are growing rapidly. Minori Group, with its business diversification in automation services and vending machines, faces a highly dynamic business environment. The vending machine market in industrial areas has experienced significant growth in line with the need for efficiency and automation in work environments, public facilities, and educational institutions (Rahardjo, 2022). However, these increased opportunities are accompanied by increasingly complex marketing and sales data.

The main problem faced by Minori Group is the lack of an integrated analysis system capable of connecting marketing and sales data in a single interactive, real-time visual platform. Information regarding pricing strategies, promotional effectiveness, machine locations, and product performance is still scattered across various systems and formats, so analysis tends to be descriptive rather than predictive. As a result, decisions are often made based on intuition rather than empirical evidence supported by analytical data (Kotler & Keller, 2021).

This condition has an impact on low marketing efficiency and suboptimal sales strategies. Without a comprehensive understanding of the interaction between the elements of the 4P marketing mix, Minori Group risks losing opportunities to increase sales, strengthen its brand position, and design effective distribution strategies. In other words, Minori Group's main challenge is how to turn data into reliable strategic insights.

The specific issue that is the focus of this study is how the implementation of a Business Intelligence (BI) system using Tableau can help Minori Group analyze the relationship between the 4Ps of marketing mix and vending machine sales KPIs. Tableau is a data visualization software that enables interactive analysis, multi-source data integration, and dynamic dashboard presentation to support fact-based decision making (Ghosh & Srivastava, 2021).

Although Tableau has been widely used in various business sectors, its application at Minori Group is currently limited to sales reporting and product stock monitoring. The potential of Tableau as a strategic marketing analysis tool has not been optimally utilized. By utilizing Tableau more deeply, Minori Group has the opportunity to gain new insights into how the combination of pricing strategies, machine location, product type, and promotional activities affect the achievement of sales KPIs.

Various studies have shown that the use of Business Intelligence and visual analysis can improve marketing and sales performance. Ghosh & Srivastava (2021) in the Journal of Marketing Analytics found that Tableau helps marketing managers understand the dynamic patterns between promotional activities and customer behavior. Al-Kilidar et al. (2020) emphasize that the application of BI in large companies increases operational efficiency and accelerates cross-departmental decision making.

Dholakia & Dholakia (2022) in their study assert that data visualization is a key element in improving an organization's ability to identify sales anomalies and optimize pricing strategies. Meanwhile, Nguyen & Simkin (2021) found that the use of interactive dashboards helps strengthen collaboration between marketing, finance, and operations teams, resulting in more coordinated strategies.

In the local context, Sari and Nugroho (2023) found that the implementation of BI in the Indonesian industrial sector still faces obstacles in the form of a lack of competent human resources and the absence of a data-driven culture. This is also a challenge for Minori Group, which is still in the early stages of building a comprehensive data analysis infrastructure.

However, there is a clear research gap: most previous studies have not specifically linked the use of Tableau with 4P marketing mix analysis and sales KPIs in the manufacturing sector, especially in the context of companies such as Minori Group that operate in Indonesian industrial estates. The majority of research focuses on the service and retail sectors, while research on the sales automation industry is still very limited (Chen et al., 2020).

This study is based on three main theories that are interrelated and form a solid conceptual foundation for explaining the relationship between data analysis, marketing strategy, and technology acceptance in an organizational environment. The first underlying theory is the Marketing Mix Theory (4Ps) proposed by Kotler and Keller (2021). This theory asserts that an effective marketing strategy must optimize four key elements, namely product, price, place, and promotion. These four elements do not stand alone but interact with each other in shaping consumer perceptions and influencing sales levels. The product determines the value that the company offers to consumers, the price is an indicator of value and market purchasing power, the place describes the availability and ease of access to the product, while promotion serves as a means of communication to build awareness and interest in the product. In the context of Minori Group, the application of the 4P concept is crucial in determining a competitive vending machine marketing strategy in the South Cikarang industrial area, given that the dynamic market demands efficiency, distribution accuracy, and a deep understanding of customer behavior.

The second theory that supports this research is the Business Intelligence (BI) and Visual Analytics Theory described by Few in Bifakhlina (2022). Business Intelligence has the main objective of transforming

raw data into actionable strategic insights, enabling organizations to make faster and more accurate decisions. In this case, Tableau as a BI tool plays an important role due to its ability to process big data from various sources and present it in an easy-to-understand visual form. Tableau helps users explore the relationship between marketing and sales variables through interactive dashboards, dynamic graphics, and visual analysis that allow users to find patterns, trends, or anomalies in marketing performance. Through intuitive visualization, decision makers at Minori Group can understand the complex correlations between promotional strategies, pricing, machine location, and sales levels without having to have in-depth statistical expertise. Thus, Tableau not only functions as a reporting tool, but also as a means of strategic analysis that strengthens the organization's ability to compete in the data-driven digital era.

The third theory that is an important pillar of this research is the Technology Acceptance Model (TAM) developed by Davis in Safari & Riyanti (2024). This model explains that the level of adoption of a technology in an organization is greatly influenced by two main factors, namely perceived usefulness and perceived ease of use. In the context of this study, the successful implementation of Tableau at Minori Group greatly depends on the extent to which employees, especially in the marketing and sales divisions, view Tableau as a useful tool for improving their performance and easy to use in their daily activities. If employees feel that Tableau helps them understand data better, saves analysis time, and produces more accurate reports, then the level of acceptance of this technology will be higher. Conversely, if the system is considered complicated or irrelevant to their needs, resistance to using the technology will increase, thereby hindering the overall effectiveness of BI implementation. Therefore, the TAM-based approach helps explain the importance of human factors in the success of digital transformation at Minori Group.

Based on the integration of these three theories, this study builds a conceptual synthesis that shows that Tableau is not just a data visualization tool, but also a strategic platform that plays an important role in connecting marketing data with sales KPIs. Tableau serves as a bridge between traditional marketing theory and modern data-driven decision-making practices. In the context of Minori Group, Tableau can be used to present interactive visualizations of the correlation between promotional strategies and sales volume, enabling management to assess the effectiveness of various marketing campaigns. In addition, Tableau can display purchasing patterns based on the location of vending machines (place element), allowing the company to understand areas with the highest transaction rates or new market potential. Through price analysis, Tableau can also help measure the effectiveness of dynamic pricing strategies on profit margins, as well as assess product performance based on customer preferences and specific transaction times.

With this kind of integrated analysis, Minori Group management is able to see a comprehensive picture of marketing and sales performance in real time. Previously separate data can be combined to generate relevant strategic insights. This enables the company to design more adaptive, evidence-based marketing strategies that are in line with changes in consumer behavior in the market. Overall, this conceptual synthesis confirms that the implementation of Tableau at Minori Group is not just a technology project, but a managerial transformation towards a data-driven organization culture. Thus, marketing mix theory, BI theory, and TAM theory complement each other in providing a strong theoretical foundation for understanding how the use of Tableau can improve the effectiveness of marketing analysis and strategic decision-making in modern organizations such as Minori Group.

The decision to focus on Minori Group was not without reason. As a company operating in a data- and technology-intensive industry, Minori Group requires a systematic analytical approach to manage its massive and diverse sales data. Tableau offers the ideal solution for these needs due to its ability to integrate various data sources, ranging from sales systems and CRM to digital marketing data, into a single integrated dashboard.

In addition, this research also aims to support Minori Group's digital transformation into a data-driven organization. With optimal implementation of Tableau, the company can build a collaborative analytical culture across divisions and make faster, more accurate decisions that have a direct impact on profitability.

2. RESEARCH METHOD

This study uses a descriptive quantitative approach supported by information system-based data analysis. The main objective of this study is to produce strategic recommendations for product management in vending machines based on actual sales data. Broadly speaking, the research process consists of five main stages as illustrated in the following flowchart:

a. Data Collection from the Vending Machine Application
   The initial stage begins with the process of collecting data from the main vending machine application, which functions as a transaction and inventory recording system. The data collected includes product type, sales volume, transaction time, and stock information. Collecting data directly from the system allows for the acquisition of actual, complete, and accurate information to support the subsequent analysis process.
b. Data Cleaning and Preliminary Processing Using Excel

The raw data obtained from the vending machine application then undergoes a cleaning and initial processing process using Microsoft Excel. This step includes removing duplicate data, handling empty values, adjusting data formats, and grouping variables according to analysis requirements. The purpose of this stage is to ensure that the data to be processed has high validity and reliability so that the analysis results can be scientifically accounted for.

c. Data Integration into Tableau for Visual Analysis and Interactive Dashboards
After the cleaning process, the data is integrated into the Tableau application. Tableau is used as a visual analysis tool to display data in the form of graphs, trend diagrams, and interactive dashboards. This visualization makes it easy to observe the relationships between variables, sales patterns, and product performance distribution dynamically. Thus, Tableau plays an important role in improving the efficiency and accuracy of data interpretation.

d. Analysis of Tableau Results to Identify Product Patterns and Performance
The next stage is to analyze the results of Tableau visualization to identify customer consumption patterns and the performance of each product. The analysis is conducted to determine products with high turnover rates, products with slow sales, and products with the greatest profit contribution. The results of this analysis form the basis for assessing the effectiveness of marketing strategies and the operational efficiency of vending machines. This is an important phase because it allows you to identify and correct data errors before proceeding to the next phase. Data management is very important in the ETL (Extract, Transform, Load) framework to avoid problems such as duplicate calculations. Before the data is entered into Tableau, there are columns for status, device ID, RCoil, MCoil, and PrcdDate. The aforementioned columns are not used for the visualization process; therefore, the researcher deleted these columns before importing them into Tableau.

e. Formulation of Strategic Recommendations for 4P and KPI Based on Analysis Results
The final stage of the research is the formulation of strategic recommendations based on the results of the analysis that has been carried out. Recommendations are formulated by considering the 4P elements (Product, Price, Place, Promotion) and relevant Key Performance Indicators (KPIs), such as stock turnover rate, profit margin, and promotion effectiveness. The final result is a strategy that can be used for decision-making in product placement, restocking policies, and increasing vending machine profitability.

3. RESULTS AND DISCUSSION

During the data processing stage, researchers processed data on product sales from vending machines owned by Minori Group. The data contained 8,774 successful transactions out of a total of 9,524 transactions, including successful, failed, and canceled transactions, in September, while in October there were 16,074 successful transactions out of a total of 17,531 transactions, including successful, failed, and canceled transactions. The researchers obtained the vending machine sales data from seven vending machines owned by the Minori Group.

As shown in Figure 1, the first stage involved searching for relevant data and entering it into Tableau. Tableau Desktop was used to visualize the data imported in CSV format.

Figure 1. Data Source Extraction

Fields or columns from the data source will appear in Tableau after the researcher receives and imports the data, as illustrated in Figure 2. This figure shows what the CSV file imported into Tableau looks like. This data is then visualized using Tableau Desktop and the visuals provided. The researcher then opens a new worksheet page to perform data filtering and visualization tasks related to vending machine sales.

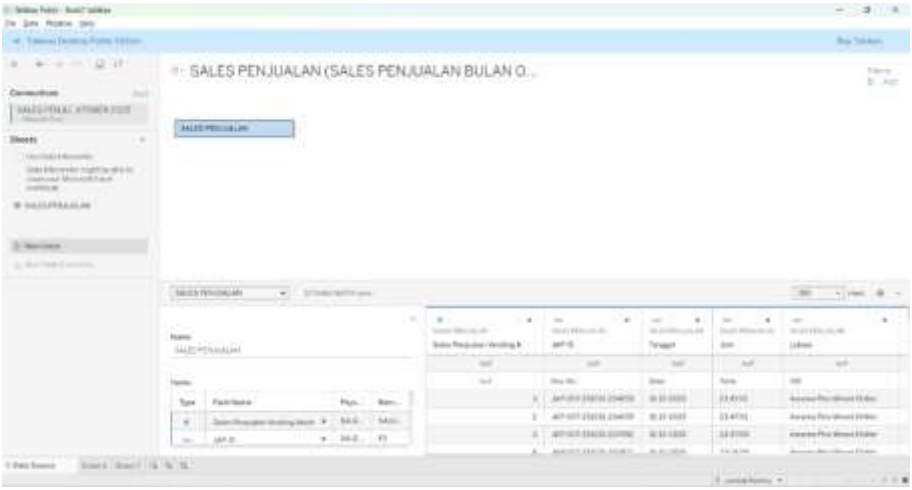

Figure 2. Data Source Display

When performing visualization, for the 4Ps, especially Product and Price, researchers only used the VM, Items, BIN, Date, and Price columns to determine the sales and revenue obtained by each vending machine based on the location of the product in the vending machine and the location of the vending machine itself.

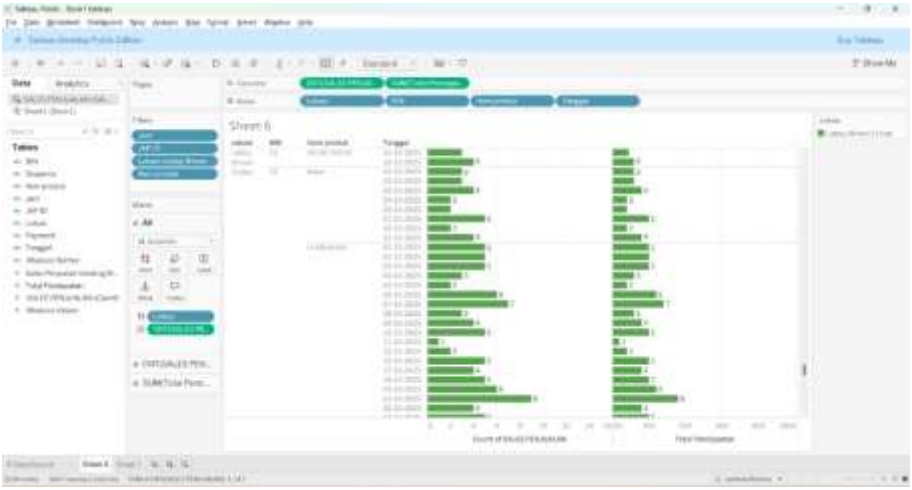

Figure 3. Product sales per date per BIN per vending machine

Meanwhile, for the sales KPI of each product as well as Place and Promotion, researchers used the VM column, product name, and columns that had been processed during the initial data processing stage using Excel so that researchers could see the KPI of each product per vending machine, thereby enabling them to provide recommendations on products, product placement, and strategies to be used to increase sales.

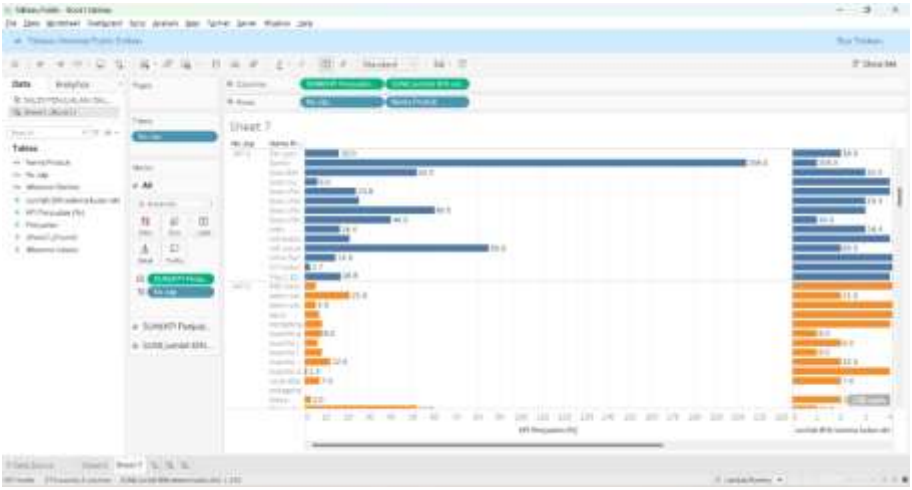

Figure 4. Product KPI per Vending Machine

In the first visualization conducted by the researcher regarding Product Sales per date per BIN per Vending Machine, the placement of products in each BIN/slot number on each date can be seen. It can be observed that each BIN/slot number is filled with several different products. From the graph results, it can be observed that in one BIN, there is not only one type of product, but several different products on different dates. For example, BIN 51 contains the product "Vit Bot 550 ml" and BIN 52 contains 'Aqua' and "Le Minerale". The replacement or mixing of products in the same slot indicates that product filling has not been done consistently for one type of product in a particular slot. This indicates that the product placement strategy is not yet optimal.

This condition has the potential to cause suboptimal sales. Consumers who are accustomed to buying certain products in certain slots may experience confusion if the available products change frequently. In addition, measuring sales performance per slot becomes less accurate because product variations in one BIN mean that the data does not consistently represent the performance of a single product. To improve the effectiveness of the Product and Price strategy, companies need to maintain consistency in product placement in each BIN. With this consistency, product performance analysis can be carried out more accurately and measurably. Therefore, to improve the effectiveness and accuracy of sales analysis, it is recommended that each BIN have one type of product that remains the same for a certain period, such as at least several weeks or once a month, so that sales patterns can be monitored more clearly and restocking strategies can be carried out more precisely.

From these conditions, it can be concluded that the product placement strategy still needs improvement. It is recommended that one BIN be filled with the same product for at least two weeks so that sales patterns can be clearly monitored. With this consistency, companies can conduct more accurate sales analysis per slot, identify products with high or low performance, and adjust restocking strategies based on more representative actual data.

In the second visualization conducted by researchers related to Product KPIs per Vending Machine, from this visualization, the company can see that the KPI (Key Performance Indicator) calculation for product sales used by researchers is ((sales amount / (number of BINs used for 1 product x number of products in 1 BIN)) x number of days in a month) / (number of sales / (total number of BINs x 5)) x number of days in a month) to measure performance against targets.

$$\text{KPI} = \frac{(\text{Jumlah Penjualan}/(\text{Jumlah BIN per Produk} \times \text{Jumlah Produk per BIN})) \times \text{Jumlah Hari dalam Sebulan}}{(\text{Jumlah Penjualan}/(\text{Jumlah BIN Keseluruhan} \times 5)) \times \text{Jumlah Hari dalam Sebulan}}$$

This formula is used to assess the effectiveness of each product's sales compared to the capacity and distribution of products in the machine.

Additional information regarding the number of BINs used during October provides important context for KPI analysis. Products with a large number of BINs but low KPIs indicate potential overstocking or products that are less in demand. Conversely, products with few BINs but high KPIs reflect high efficiency and the potential to increase the number of slots.

The visualization shows that each product has a different KPI value, indicating uneven sales performance levels. For example, products such as Sprite and Ultra Milk have high KPI values (more than 50%), indicating poor sales relative to the number of slots allocated, as the standard for this KPI is a minimum of 70%. Conversely, other products such as ABC Coffee or Coca Cola show much lower KPI values, indicating suboptimal sales performance or ineffective product placement in vending machines.

Additional information on the right side of the graph shows the number of BINs used during October, which helps correlate KPI performance with product distribution in the machine. Products with a large number of BINs but low KPIs indicate potential overstocking or a lack of consumer interest in those products. Conversely, products with few BINs but high KPIs indicate high sales efficiency.

In the context of Business Intelligence (BI) and Visual Analytics, this process illustrates how raw data is processed into strategically valuable information through a visual approach. BI enables companies to make data-driven decisions by utilizing the results processed by Tableau to interactively view patterns, trends, and relationships between variables. Visualization of KPIs per vending machine provides a comprehensive view of product performance, slot capacity, and demand levels, allowing decision makers to immediately identify areas for optimization without having to manually analyze raw data. According to TAM, the two main factors that influence technology acceptance are perceived usefulness and perceived ease of use. With Tableau, users can easily understand product performance through intuitive and informative visualizations, thereby increasing confidence in the analysis results and encouraging the continued use of BI in operational activities.

Overall, this visualization allows companies to objectively assess the performance of each product and make strategic decisions in rearranging product slots and selecting products to be sold in vending machines. Products with high KPIs can be prioritized for additional slots or more frequent refills, while products with low KPIs can be reevaluated in terms of market demand, placement location, or promotional strategy.

3. CONCLUSION

From the visualization and analysis, it can be concluded that product placement and management in vending machines are still suboptimal. Inconsistencies in product replenishment within each BIN make it difficult to accurately analyze sales data and potentially lead to consumer confusion. Therefore, a consistent replenishment system is needed, where each BIN is filled with a single product type within a specific period to clearly observe sales patterns and develop more precise restocking strategies. Furthermore, the results of the Product KPI measurement per Vending Machine indicate variations in sales performance between products. Some products have high KPI values but have not yet reached expected standards, while others show low performance despite having a large number of slots. These findings emphasize the importance of evaluating product placement, the number of allocated slots, and the effectiveness of promotional strategies. Overall, this visualization helps companies understand the relationship between product placement, the number of slots, and sales levels, thus providing a basis for strategic decision-making. With improvements in Product, Place, and Promotion, companies can increase sales efficiency, optimize vending machine performance, and maximize profits from each product offered.

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